Fiscal Externalities In The Globally Integrated Market

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ABSTRACT

While tax competition of mobile capital has been explored in the literature, little attention has been paid to the effects on business incentives for global trading. We show that tax competition creates negative fiscal externalities via distorted production decisions of multinational companies, when the markets across countries are interrelated through intra-firm trade. Pareto improvement may emerge once the governance of the interrelated markets is coordinated across different governments.

INTRODUCTION

With globalization of the economy, domestic corporate tax policies are increasingly a source of friction within international trade. Growing multinational business hinders the enforcement of independent tax legislation in many countries. Cross-border transactions among related parties increase the scope for tax avoidance. Governments have recognized the necessity to regulate tax evasion. However, they fear the consequent impediment tax regulations may cause to global trading. This issue has been brought to light by growing market integration movements such as the EU. International tax policy is one of the major policy debates facing the OECD and WTO.

This paper studies fiscal externalities in the global market. The effects of tax competition have been thoroughly explored in the literature [see the special issue of Journal of Public Economics (2005) and the survey by Wilson (1999), etc.]. However, little is known about the externalities that result from jurisdictional tax policies on production decisions of multinational companies. We relate fiscal externality issues to trade of intermediate goods. Trade of intermediate goods is one of growing concern in the literature (Hummels et al., 2001; Hanson et al., 2003; Yi, 2003). The analysis considers the case when markets across different countries are interrelated via intra-firm trade conducted by multinational companies. We characterize the consequences of recent tax competition between countries, often described as an "international tax war."

Our analysis is distinct from the standard discussion. The typical discussion focuses on the determination of transfer prices. Due to different policy concerns, this paper focuses on the asymmetry of two policy instruments: tax rates and transfer prices. Under the current tax systems, the Bilateral Advanced Pricing Agreement coordinates the setting of a transfer price between countries. But domestic tax instruments, such as tax rates, are still autonomously determined in each country. We examine how domestic tax instruments cause externalities on production decisions of multinational companies.

Our analysis shows that gross profits (or tax bases) are greater once the governance of interrelated markets is coordinated across governments. Even though multinational companies are integrated businesses under common control, the companies cannot internalize the costs of intra-firm transactions under jurisdictional tax systems. The systems segregate the profits earned by different affiliates within the same company, based on location, for the purpose of imposing taxes independently. The loss of efficiency in this paper is analogous to the inefficiency caused by double marginalization of monopolies seen in the industrial organization literature. The analysis suggests that, in addition to cross-border tax instruments, domestic tax instruments should be coordinated in the global economy.

This paper will proceed as follows. Section 2 reviews the literature. Section 3 illustrates how tax competition causes an efficiency loss. Section 4 proposes ways of eliminating the inefficiency. Section 5 concludes the paper and Section 6 suggests directions for future research.

THE LITERATURE

This paper introduces the internal organization of a firm to the discussion on tax competition. The model falls in between those found in the classic literature on source-based capital tax competition (Wilson, 1986; Zodrow and Mieszkowski, 1986; Mieszkowski and Zodrow, 1989) and the ones in the literature on transfer pricing of multinational companies (Haufler and Schjelderup, 2000; Madan, 2000; Zhao, 2000; Gresik, 2001; Swenson, 2001). Specifically, we construct a model incorporating the recent tax regulations such as the Bilateral Advanced Pricing Agreement (BAPA) (Tomohara, 2004). The BAPA is an agreement between tax authorities in two countries and a multinational company. The agreement is to use the same arm's length price in both locations. The analysis safely ignores both private information and commitment issues, which are often the focus of work on transfer pricing. Nevertheless, there is still a problem. The multinational company reduces its tax burden by adjusting output (which impacts the volume of trade) to generate higher profits in the country with the lower tax rate. This tax-induced trade distortion plays an intermediary role in creating negative fiscal externalities.

The analysis in this paper differs from the standard models. The literature studies tax competition among multiple host countries (or states, counties, etc.). The location of investment is an issue when capital can move freely between host countries. We consider tax competition between a home country and a host country. The relationship between the two countries has already been established through intra-firm trade of a multinational company. One possible interpretation is that our analysis studies tax competition after capital locates in a host country.

The model includes characteristics of both vertical and horizontal fiscal externalities. This is because markets across countries are interrelated by intra-firm trade of multinational companies. Governments in different countries share a tax base in the analysis. This situation is analogous to the vertical fiscal externalities seen in Boadway and Keen (1996), Boadway et al. (1998), and Keen and Kotsogiannis (2002), in which the tax bases of state governments overlap with the tax base of the federal government. Tax arbitrage in this paper (a company generates more profit in the country with a lower tax rate) has some likeliness to the horizontal fiscal externalities seen in Zodrow and Mieszkowski (1986), Wilson (1986), Mieszkowski and Zodrow (1989), and Wildasin (1991).

The implication, tax competition is inefficient, is the same as in the standard models. However, the mechanisms causing inefficiency here are different. In the standard models (where governments maximize social welfare of citizens), tax competition of mobile capital is undesirable since it results in under-provision of public services. Inefficiency results from coordination failure between governments. We introduce the decision-making of a company into the fiscal externality argument. Therefore, in addition to governments' coordination failure, tax-induced production distortion plays an important role in causing inefficiency. Little attention has been given to this point in the previous literature. This paper provides an analytical framework for studying the harmful effects of tax competition on business incentives for global trading.

INTERNATIONAL TAX COMPETITION

An individual household consumes two goods; a good, q, and the numeraire good, z. Suppose a multi-national company serves the local market for q and competitive firms produce z, as in the literature on tax competition and foreign direct investment (Markusen et al., 1995; Haufler and Wooton, 1999). We assume that the multinational company has a monopoly on its differentiated goods in the local market. Multinational companies are usually able to extract monopoly rent. The rent more than compensates for the cost disadvantage of entering the foreign market. Firm-specific knowledge makes their goods unique.

A representative household, i, has the utility function

$$u_i = aq_i - \frac{1}{2}\beta q_i^2 + z_i, \text{ where } a > 0 \text{ and } \beta > 0. \quad (1)$$

We denote $z = \sum_{i=1}^{n} z_i$ and $q = \sum_{i=1}^{n} q_i$, assuming there are n identical households in the country. Each household owns one unit of labor. Labor earns a wage of w in units of the numeraire good. Suppose tax revenues from the multinational company are distributed equally among all households. The household's budget constraint is expressed as

$$w + g_i = z_i + pq_i \quad (2)$$

where g_i is per capita tax revenues and p is the price of q measured in units of z. Maximizing (1) subject to (2) and aggregating over households yields an inverse demand function for q:

$$p = a - bq, \text{ where } b = \frac{\beta}{n} > 0. \quad (3)$$

The markets across two countries are interrelated through an intra-firm transaction of a vertically integrated multinational company. Trade within a firm is modeled as a manufacturing process from a mother factory in an upstream location to assembly (or distribution) facilities in the destination market. A typical example is a parent company in the home country producing and exporting intermediate goods that are further assembled or manufactured by a subsidiary in the host country. Final goods are sold in the local markets of the host country.

Following the vertical integration literature, the intra-firm transaction is characterized as a fixed-coefficient production function. Let $m > 0$ be the quantity of intermediate goods produced by a multinational parent in the home country, and $q > 0$ be the quantity of final goods processed by a subsidiary in the host country. The production function is denoted as $q = \alpha m$, where α is a positive constant. This assumes that the amount of a local input required for production is proportional to m. We use $\alpha = 1$. With the proper choice of units, one unit of the intermediate good is required to produce one unit of the final good.

The factor markets are characterized as competitive (in both the home and host countries). Many local companies provide non-differentiated components necessary for production. We use a linear cost function, $C_i = c_i q$, where c_i is a positive constant marginal cost in location i. The location is denoted as $i = h$ for the home country and $i = f$ for the host country. Each affiliate pays corporate income taxes calculated at a corporate tax rate, t_i, in its resident country.

A transfer price is regulated as $\bar{\theta} = (1 + k)c_h$ with a constant mark-up rate $k > 0$. The multinational company and the two governments agree upon the mark-up in advance. The mark-up rate is decided by referring to market conditions at the industry level (i.e., it is not chosen strategically by either the governments or the company). This is the so called Bilateral Advanced Pricing Agreement (BAPA) case. This case ignores both private information and commitment issues, which are the focus of much work on transfer pricing. We highlight the inefficiency arising from domestic tax policies under the BAPA system.

The multinational company chooses output to maximize after-tax profits of the group. Global profit maximization is assumed, as is typical in the literature, though companies may have multiple objectives and could

possibly benefit from decentralization. The after-tax global profits of the multinational company are the sum of profits earned in the two countries:

$$\Pi = \left((1-t_h)(\bar{\theta} - c_h) + (1-t_f)\left(p - \bar{\theta} - c_f\right)\right)q. \tag{4}$$

The first-order condition (which is also a sufficient condition) provides the familiar, but slightly modified relationship. The after-tax marginal revenue is equated to the after-tax marginal cost at the group level.

$$(1-t_h)\bar{\theta} + (1-t_f)(a-2bq) = (1-t_h)c_h + (1-t_f)\left(\bar{\theta} + c_f\right). \tag{5}$$

Equilibrium output is solved for as a simple function of relative tax rates in two countries:

$$q^* = \frac{1}{2b}\left(A + (1-t^e)B\right), \text{ where } A = a - \bar{\theta} - c_f,\ B = \bar{\theta} - c_h, \text{ and } 1-t^e = \frac{1-t_h}{1-t_f} \tag{6}$$

(and q^* is a finite quantity from $t_f \neq 1$). Equation (6) indicates that domestic tax policies have externalities. Tax rates in different countries influence production decisions of multinational companies. The companies' production decisions impact the volume of trade since, with a vertically integrated structure, the demand for intermediate goods is derived indirectly from the demand for the final goods.

Proposition 1

The optimal volume of trade, q^*, is decreasing in the upstream location tax rate, t_h, and increasing in the downstream location tax rate, t_f, when the markets across two countries are interrelated through an intra-firm transaction of a vertically integrated multinational company.

Proof

$$\frac{\partial q}{\partial t_h} = \frac{-B}{2b(1-t_f)} < 0, \quad \text{and} \quad \frac{\partial q}{\partial t_f} = \frac{B(1-t_h)}{2b(1-t_f)^2} > 0. \text{ ///}$$

The multinational company maximizes after-tax consolidated profits by choosing the level of output that equates the after-tax marginal revenue (the left-hand side of Equation (5)) to the after-tax marginal cost (the right-hand side). Proposition 1 is the result of balancing the benefits (cost savings from the income deduction) and the costs (increased tax payments). For example, an increase in the host tax rate causes both marginal cost and marginal revenue to decrease. Marginal revenue decreases due to an increase in tax payments to the host country. Marginal cost decreases due to the cost savings from the income deduction. Since companies are allowed to deduct costs from their tax base, an increase in the tax rate increases corporate profits via the income deduction term $\left(t_h c_h + t_f\left(\bar{\theta} + c_f\right)\right)q$. The effects of decreasing marginal cost always dominate the decrease in marginal revenue (from the first order condition). Therefore, it is profitable for the company to increase production when the host country's tax rate is increased.

The logic of the results follows an argument similar to the one used to explain tax arbitrage via transfer pricing. Under the standard rule for transfer pricing, tax evasion is achieved by manipulating transfer prices such that income is allocated to the country with lower tax rates. In this case, instead of using transfer pricing (which is regulated), a company tries to increase after-tax global profits by adjusting output to generate more profits in the country where the tax rate is relatively low. The relative tax rates between the two countries play a key role in

deciding the equilibrium output and, therefore, the optimal volume of trade. We will come back to this point when discussing tax policies.

We develop a non-cooperative tax game in a two-jurisdictional model. Tax authorities, in two different countries, under independent tax systems, compete for tax revenues from a multinational company. While governments may have other objectives, revenue maximization captures recent tax competition that is often described as a "tax war" between different tax jurisdictions. The set of players is $N = \{f, h\}$, where f represents the tax authority in the foreign host country and h represents the one in the home country. Each government chooses a pure strategy tax rate to maximize tax revenue, while taking the tax rate set by the other country as given. The set of pure strategies (i.e., tax rates) available to each player, $i \in N$, is $S_i = [0,1]$ (i.e., governments cannot impose a tax rate greater than 100%). The analysis focuses on a pure strategy equilibrium, not a mixed strategy equilibrium, because it is natural to assume that governments do not decide their tax rates randomly. We refer to a pure strategy profile, $t = (t_f, t_h)$, as an outcome, and denote the set $S_f \times S_h$ of outcomes by S. A payoff function is expressed as $T_i : S \to \Re_+$. Such a tax competition game is defined as the game $< N, (S_i), (T_i) >$.

Tax revenues in each country are functions of cost and demand parameters

$$T_h = \frac{Bt_h}{2b}\left(A + (1 - t^e)B\right) \qquad \text{and} \tag{7}$$

$$T_f = \frac{t_f}{4b}\left(A^2 - \left((1 - t^e)B\right)^2\right). \tag{8}$$

Note that the optimal output of the company (solved for in the previous section) is embodied in these payoffs. The parameter B is before-tax per unit profit of the multinational affiliate in the home country. The parameter A is positively correlated with before-tax per unit profit of the affiliate in the host country; the per unit profit in the host country is $A - bq$.

The tax revenue in the home country is positively related to both parameters A and B. However, B does not positively affect revenue in the host country. The former is explained by the fact that the tax base (i.e., profit) in the home country is derived from the demand for final products in the host market. Larger final sales in the host country (which result from a larger A) translate into higher demand for intermediate goods. This will induce more profits in the home country, when profits in the home country are monotonically increasing in sales. The claim that B is not positively associated with revenue in the host country can be explained by the fact that a larger amount of output is produced under profit maximization of global profits, as opposed to profit maximization only in the host country. At larger B, the affiliate in the home country is motivated to increase sales to increase profits. However, the price of final goods in the host market must decrease to achieve higher levels of sales. Since such a decrease in price always dominates the increase in output, the tax base in the host country includes parameter B as a negative element.

We analyze the tax competition game using a Nash equilibrium. This equilibrium captures the nature of self-interested governments, motivated by a desire for increased tax revenue under national sovereignty. Denote $E = B/A$. For all E such that $0 < E \leq 3$, a profile of tax rates (t_f^*, t_h^*) such that

$$t_f^* = \frac{1}{15}\left(13 - 2E - \left(J + 30E\sqrt{K}\right)^{\frac{1}{3}} - \left(J - 30E\sqrt{K}\right)^{\frac{1}{3}}\right) \qquad \text{and} \tag{9}$$

$$t_h^* = \frac{1}{2}\left[1+\frac{1}{15E}\left\{2+2E+\left(J+30E\sqrt{K}\right)^{\frac{1}{3}}+\left(J-30E\sqrt{K}\right)^{\frac{1}{3}}\right\}\right], \quad (10)$$

where $J = 8-156E+474E^2-37E^3$, $K = 3E^4-18E^3+360E^2-24E$, is a Nash equilibrium in pure strategies of the tax competition game $< N,(A_i),(T_i) >$.[1]

A Nash equilibrium is solved as a function of E, which is correlated with the difference in profit per unit between the two countries. In fact, the parameter E is equivalent to the difference in the tax bases, since the tax base is calculated by multiplying the per unit profit by sales (which are the same in both countries). Specifically, $E = 1/3$ marks an important critical value in determining equilibrium tax rates. The home country's tax base is shown to be larger than the host country's one if $E > 1/3$, and vice versa if $E < 1/3$. The value of E approaches 3 if the home country's profit dominates global profits and approaches 0 if the host country's profit dominates global profits. Thus, we characterize the relationship between each country's tax strategy under tax competition and the difference of the tax bases in two countries as follows:

Proposition 2

The country with the larger tax base levies a higher tax rate than the country with the smaller tax base under an equilibrium of the tax competition game $< N,(A_i),(T_i) >$.

It seems intuitive that a government with a larger tax base levies taxes on multinational companies more aggressively than a government with a smaller tax base. Observed corporate tax rates in developed countries are much higher than in developing countries. The KPMG corporate tax rate survey states: "stronger economies are more likely to have higher corporate tax rates." Countries, where multinational companies do not have a comparative advantage in producing high value added products due to insufficient infrastructure, often charge lower tax rates in order to induce foreign direct investment. Our proposition may be related to the KPMG survey result, although this statement needs to be verified using more general analysis.

Our result is related to investment distortion in capital tax competition, while the mechanisms driving the results are different, (Bucovetsky, 1991; Wilson 1991). The literature demonstrates that when two countries of different population size are compared, the larger country levies higher tax rates since the supply of capital is less responsive to tax changes. If we redefine a larger country as the country with many multinational companies, our results are consistent with the findings in the literature.

Proposition 3

The equilibrium tax rates of the game $< N,(A_i),(T_i) >$ are increasing in the intercept of the inverse demand function a, and decreasing in the marginal cost in both countries c_h and c_f.

Proof

See Appendix.

The equilibrium tax rates are higher when a company faces more favorable market demand and cost conditions. The intercept of the inverse demand function is higher when either the potential size of the market or the maximum willingness to pay of consumers is larger. Marginal costs in either the home or host country are smaller when companies possess more advanced production technology and/or factor inputs are cheaper. Since higher profits

are more likely to occur under the conditions listed above, tax authorities can levy higher tax rates to expropriate a portion of the benefits.

One last remark regarding tax rates is in order. Tax rates in this analysis do not necessarily mean statutory rates. It is more appropriate to regard these as effective rates, including an adjustment for income deduction. We often observe that governments tailor income taxes either to specific industries or to foreign companies by establishing special treatment provisions such as accelerated depreciation for certain types of investments (ITEP, 2000). For example, decelerated depreciation for plant investment will function as a tax increase for foreign companies, who are relatively new entrants to the market and need to make large fixed capital investments. Effective tax rates could vary by industry and company despite the single statutory tax rate. This argument refutes the criticism of the analysis where governments decide domestic tax rates solely from the revenues from multinational companies.

POLICY ANALYSIS

This section examines policy coordination with self-interested governments and the impact of such a tax policy on the size of the market. Our analysis begins to consider a global tax authority plan, where a single government levies taxes on multinational companies (or governments across countries plan and execute tax policies as if they were a single government). Consolidated tax revenues in the two countries are denoted as T. The governments' tax coordination can be expressed as follows:

$$\underset{t_f,t_h}{Max}\ T=\frac{B^2}{4b}(D+\rho)\left(2t_h+t_f(D-\rho)\right)\ \textit{subject to}\ \Pi(t_f,t_h)\geq\Pi(t_f^*,t_h^*),$$

where $D=\frac{A}{B}$, $\rho=\frac{1-t_h}{1-t_f}$, and $\Pi(t_f,t_h)=\frac{B}{4b}\left(2HD+\frac{H^2}{F}+FD^2\right)$,

where $H=1-t_h$, and $F=1-t_f$.

For notational convenience, we use $D=A/B$ instead of $E=B/A$ in this section. The government tries to maximize joint tax revenues without reducing after-tax profits of a multinational company below the level of profits resulting from tax competition. Applying the Kuhn-Tucker Theorem to the optimization problem, we obtain an equilibrium of tax coordination as a profile of tax rates (t_f^{**},t_h^{**}) such that

$$(t_f^{**},t_h^{**})=(1-\frac{G}{(1+D)^2},1-\frac{G}{(1+D)^2}),$$

where $G=2H^*D+\frac{H^{*2}}{F^*}+F^*D^2$, $H^*=1-t_h^*$ and $F^*=1-t_f^*$.

The equilibrium tax rates are always in $[0,1]^2$ since the second term of the equilibrium tax rates can be rewritten as the ratio of the after-tax profit under tax competition $\Pi(t_f^*,t_h^*)>0$ and the profit without any taxes $\Pi(0,0)>0$:

$$0<G/(1+D)^2=\Pi(t_f^*,t_h^*)/\Pi(0,0)<1.$$

To engage in policy analysis, welfare consequences of the two different tax regimes are compared.

Proposition 4

A global tax authority plan increases the tax base relative to tax competition.

Proof

See Appendix.

Proposition 4 indicates that the equilibrium output, q^*, obtained under jurisdictional tax systems is not efficient. Tax coordination between self-interested governments has the potential to enlarge before-tax company profits (the tax base) via a more efficient allocation of the tax burden.

Let us clarify the cause and mechanism of the negative externalities, created by jurisdictional tax policies, on the production decisions of multinational companies. Let q^M be the solution to the problem of maximizing the tax base. Output q^M is an equilibrium output if $t_f = t_h$ or $k = 0$ in Equation (4) (or an output under a global tax authority plan). This is illustrated by rewriting Equation (4) as

$$\Pi = (1 - t_f)(p - c_h - c_f)q + (t_f - t_h)(\bar{\theta} - c_h)q \,. \tag{11}$$

The tax base is maximized when the company maximizes profits as if it were in a single country. The first term on the right-hand side of (11) is after-tax profits when all of the company's activities are concentrated in a single jurisdiction, with the host tax rate t_f. The second term disappears under a global tax authority plan. When a global tax authority levies taxes on a multinational company, the company's decision-making simplifies to the familiar textbook monopoly model. The company maximizes monopoly rents as if there were no taxes.

Larger profits are possible because tax coordination allows multinational companies to take advantage of vertical integration, which is restricted under jurisdictional tax systems. The current tax systems segregate profits earned by different affiliates within the same company for the purpose of imposing taxes independently. With the profit function, a company has an incentive to save on taxes by adjusting its production, when tax rates differ across jurisdictions. Output adjustments play an intermediary role in creating an efficiency loss under tax competition. Output adjustments cause the company either to produce too much or too little, and result in lower profits. Either a uniform tax rate or a zero mark-up ratio can eliminate the segmentation between the two affiliates and allow the company to increase profits by internalizing the cost of the intra-firm transaction.

The efficiency loss here is fully understood only in the context of a global tax authority plan. Let us consider a Nash bargaining solution, as an alternative, which is a profile of tax rates such as

$$(t_f^{**}, t_h^{**}) = \arg\max(T_f(t_f, t_h) - T_f^*)(T_h(t_f, t_h) - T_h^*) \text{, where } T_f^* = T_f(t_f^*, t_h^*) \text{ and } T_h^* = T_h(t_f^*, t_h^*) .$$

The Nash bargaining approach remedies coordination failure between the two governments but does not eliminate the efficiency loss caused by tax-induced production distortion. An example is shown in Figure 1. Figure 1 reveals contour curves for the initial levels of tax revenues, the company's after-tax profits, and total consumption of good q as functions of the two countries' tax rates. We use indices obtained under the tax competition game as initial levels. For example, the iso-tax-revenue curve, T^*, plots the profiles of tax rates that provide the joint tax revenue level under the tax competition game. Larger joint tax revenues are obtained above the line. Other indices are plotted similarly. These indices take larger values in the area towards which the arrows point. The figure indicates that any tax rate profiles in the horizontally shaded area (1) will increase joint tax revenue levels, after-tax profits, and consumption, all together. The Nash bargaining solution, which guarantees an increase in tax revenues for both countries, occurs in the vertically shaded area (2). The Nash bargaining solution increases tax revenues at the expense

of corporate profits (and consumption). The Nash bargaining solution does not achieve a Pareto improvement whereas the global tax authority plan does. Policy cooperation under jurisdictional tax systems (such as the Nash bargaining solution) is not sufficient to eliminate efficiency loss. Further coordination is necessary to attain larger tax revenue through enlarged profits. The result suggests that tax systems should be restructured to integrate tax administration across different countries.

We can characterize the welfare consequences of two different tax regimes as follows:

Theorem

A global tax authority plan improves social welfare relative to tax competition, if under tax competition, the home tax rate t_h is higher than the host tax rate t_f .

Proof

See Appendix.

A general sketch of the proof is as follows. The utility function of a representative household i is expressed as $u_i = (\beta q_i^2/2) + w + g_i$ (obtained by substituting equations (2) and (3) into (1)). Assuming there are n identical households in the country, we know that tax coordination increases g_i from Proposition 4. Wage is exogenous, decided via a competitive labor market. It follows that a global tax authority improves social welfare, when compared to tax competition, if the consumption of goods q_i increases.

A global tax authority plan increases the level of consumption if and only if the home country, in an upstream location, overcharges the tax rate relative to the host country, in a downstream location. This is because there are two different mechanisms capable of increasing the tax base under tax coordination. If $t_h^* > t_f^*$, a large increase in the tax base results from selling a higher quantity at a lower price. Consumers would benefit from tax coordination. The volume of trade is initially small since the country in an upstream location levies a higher tax rate (see Proposition 1). On the other hand, if $t_h^* < t_f^*$, the multinational company achieves higher before-tax profits by reducing the supply of goods via increasing the price. Tax coordination provides monopoly rents to the company. In the latter case, the degree to which tax coordination affects consumers is not obvious. There exists the trade-off between increased tax revenue and decreased consumption.

The results imply that a global tax authority plan may benefit consumers in developing countries. Consider the case where the markets between developed and developing countries are related by the intra-firm trade of a vertically integrated multinational company. The multinational company has a subsidiary in a developing country to exploit comparative advantage (e.g., cheap labor). The multinational parent in a developed country exports intermediate goods to its subsidiary to complete the manufacturing process. Final products are sold in the local market. Remember, observed corporate tax rates in developed countries are much higher than in developing countries. Thus, the current volume of trade can be too small and, consequently, the potential for enhanced trade under a global tax authority exists. An increased trade volume will provide higher tax revenues via increased corporate profits. Both governments and the company benefit. Consumers in developing countries, who are not able to buy products, can enjoy the goods due to a decreased price. Pareto improvement may emerge once the governance of interconnected markets is coordinated across both governments. While the reality is more complicated and we have to be careful about interpreting the results, our analysis sheds light on the negative externalities, created by jurisdictional tax policies, on production decisions of multinational companies.

CONCLUSIONS

This paper characterizes the consequences of tax competition when markets in two countries are interrelated through intra-firm trade of a multinational company. Nash equilibrium tax rates under tax competition differ between the countries hosting the parent and the subsidiary, since the two countries face different tax bases. The country with the larger tax base levies a higher tax rate than the country with the smaller tax base. The difference in tax rates distorts production decisions of the multinational company. The company reduces its tax burden by adjusting output to increase profit in the country with a lower tax rate. Jurisdictional tax policies cause fiscal externalities via the distorted production decisions of multinational companies.

The equilibrium output under tax competition is not efficient. Tax coordination between self-interested governments has the potential for enlarging before-tax profits of a company through a more efficient allocation of the tax burden. The source of inefficiency is coordination failure between the two governments, when both countries share a tax base. Output adjustments play an intermediate role in creating the efficiency loss. Pareto improvement may emerge once the governance of interconnected markets is coordinated across the two governments.

Policy effectiveness is often limited without cooperative planning and implementation, because one policy may create externalities that are detrimental to other policy objectives in the areas of tax, trade, and competition. The analysis reveals that corporate tax policy works as trade and industrial policies can influence the market. The result suggests that domestic tax policies, as well as trade policies, should be coordinated in the global economy. Such coordination needs to include not only collaborative policy planning, but collaborative implementation as well.

SUGGESTIONS FOR FUTURE RESEARCH

Considering the recent rapid growth in intra-firm trade, our analysis provides potentially useful information for tax planning practitioners. Once the values of the cost and demand parameters are specified, specific functional forms allow us to conduct a numerical simulation to examine the consequences of different tax policies. The degree to which tax coordination improves social welfare and the policy's impact on trade can be established. Tomohara (2005) calibrates the welfare impacts of a global tax authority plan using the US-Japan automotive trade case. He estimates demand parameters following the trade literature on the VER and obtains cost parameters using firms' financial statements. The importance for studying the effects of tax competition will increase as the degree of globalization progresses over the next few decades.

APPENDIX

1. Best response functions

Rearranging the first order conditions obtained from (7) and (8) yields the best response functions of the home and host countries:

$$t_h^{\,*} = \frac{1}{2}\left(1 + \frac{1 - t_f}{E}\right) \qquad (12) \qquad \text{and} \qquad t_h = 1 - \left(\frac{1}{E}\right)\left(\frac{(1 - t_f^{\,*})^3}{1 + t_f^{\,*}}\right)^{\frac{1}{2}} \qquad (13)$$

where $t_i^{\,*}$ for all $i \in N$ is the best response for each country.

2. The parameter E and the tax bases ratio TB

The value $E = 1/3$ is equivalent to the case where the tax base in the home country, TB_h, is equal to the tax base in the host country, TB_f.

Denote the ratio of TB_h over TB_f as TB. From Equation (6), this can be expressed as $TB = 2E/(1-\rho E)$, where $\rho = (1-t_h(E))/(1-t_f(E))$. First, show if $E = 1/3$, then $TB = 1$. Substituting $E = 1/3$ and $\rho = 1$ (from Equation (9) and (10)) into TB yields a solution of one. Next, show if $TB = 1$, then $E = 1/3$. Solving $1-\rho E = 2E$ using (9) and (10) provides $E = 1/3$, after abandoning complex solutions. ///

3. *Proposition 2*

If the tax base in the home country, TB_h, is larger than the tax base in the host country, TB_f, then $t_h^* > t_f^*$.

Suppose $t_h^* \le t_f^*$. This can be rearranged as $(2E+1)t_f^* - E - 1 \ge 0$ (from (12)), which is equivalent to $E \le 1/3$. $TB_f - TB_h = \left(1-(1-t^{e*}+2)E\right)Aq$. Since we know that $A > 0$ and $q > 0$, the sign of the equation $TB_f - TB_h$ is the same as the sign of $1-(1-t^{e*}+2)E$. For $0 \le E \le 1/3$, a numerical approach shows that $1-(1-t^{e*}+2)E \ge 0$. /// Similarly, it is shown that if the tax base in the host country, TB_f, is larger than the tax base in the home country, TB_h, then $t_h^* < t_f^*$ .///

4. *Proof of Proposition 3*

First, show that if $0 \le E \le 3$, then t_h^* is a monotonically decreasing function of E. Suppose $dt_h^*/dE \ge 0$ for some E such that $0 \le E \le 3$.

$$\frac{dt_h^*}{dE} = -\frac{Y}{90EX^{\frac{4}{3}}}(X^{\frac{2}{3}} - 4 + 52E + 11E^2) + \frac{1}{30E^2X^{\frac{1}{3}}}(4 + 11E^2 - 2X^{\frac{1}{3}} + X^{\frac{2}{3}}),$$

where $X = 8 - 156E + 474E^2 - 37E^3 + 30E\sqrt{3E^4 - 18E^3 + 360E^2 - 24E}$ and

$$Y = 156 + 111E^2 - 948E + 45\sqrt{3E^4 - 18E^3 + 360E^2 - 24E}$$
$$+ 15\sqrt{3}\frac{\left(\sqrt{E}\right)^3}{\sqrt{E^3 - 6E^2 + 120E - 8}}(120 - 12E + 3E^2) \quad .$$

This is greater than or equal to zero if E takes a value such that $E \le 0$. ///

Show that if $0 \le E \le 3$, then t_f^* is a monotonic decreasing function of E. Here, we use a geometric approach. Figure 2a and 2b depict the best response functions in either the home or host country. The optimal tax rate for the host country, t_f^*, is an increasing function of the home tax rate and the optimal tax rate for the home country, t_h^*, is a decreasing function of the host tax rate from the inequalities:

$$\frac{dt_h}{dt_f^*} = \frac{1}{2E}\left(\frac{(1-t_f)^3}{1+t_f}\right)^{-\frac{1}{2}}\left(\frac{3(1-t_f)^2(1+t_f)+(1-t_f)^3}{(1+t_f)^2}\right) > 0, \text{ and } \frac{dt_h^*}{dt_f} = -\frac{1}{2E} < 0.$$

A decrease in E makes the influence of the negative term in (13) larger. To hold the equality given t_h, t_f^* needs to increase. Similarly, t_h^* needs to increase to maintain the equality of Equation (12) given t_f; a smaller E not only makes the intercept of t_h^* larger but a smaller E also makes t_h^* more responsive to changes in t_f. Hence, a decrease in *E* induces an outward shift in both best response curves, as shown in Figures 2a and 2b. Figure 2c depicts the transition of the equilibrium tax rates. ///

The equilibrium tax rates (t_f^*, t_h^*) are monotonically decreasing functions of E. The results are obvious from

$$\frac{E}{\partial a} = -\frac{B}{A^2} < 0,\ \frac{E}{\partial c_h} = \frac{k(a - c_f)}{A^2} > 0,\ \text{and}\ \frac{E}{\partial c_f} = \frac{B}{A^2} > 0\ .\ ///$$

5. Proof of Proposition 4

Show $T(t_f^{**}, t_h^{**}) \geq T(t_f^*, t_h^*)$. Define t' be a reservation tax rate, which satisfies $T(t', t') = T(t_f^*, t_h^*)$. Since $T(t,t)$ is a monotonically increasing function of a tax rate, once we show that, for all E such that $0 \leq E \leq 3$, $t^{**} \geq t'$ and the proof is done.

Given the previous notation, the reservation tax rate is calculated as

$$t' = \frac{2(1 - H^*)\left(D + \frac{H^*}{F^*}\right) + (1 - F^*)\left(D^2 - \frac{H^{*2}}{F^{*2}}\right)}{(1 + D)^2}.$$

The inequality $t^{**} \geq t'$ can be shown to be equivalent to $\left(t_h^* - t_f^*\right)^2 \geq 0$, which is true. Last, the tax base is the sum of after-tax global profits and the two countries' tax revenues. Tax coordination can raise tax revenues without lowering after-tax profits. Thus, the tax base increases. ///

6. Proof of Theorem

The utility function of a representative household is expressed as $u_i = (\beta q_i^2/2) + w + g_i$ by substituting Equations (2) and (3) into Equation (1). Wage, decided in a competitive labor market, is exogenous. Since we know that tax coordination always increases g_i, the proof is complete once we show $q_i^M > q_i^*$ for all $t_h^* > t_f^*$ (or $1/3 < E \leq 3$).

Show $q^M > q^*$ if $1/3 < E \leq 3$. Suppose $q^M \leq q^*$ for some E s.t. $1/3 < E \leq 3$. The difference $q^M - q^* = Bt^{e*}/2b$ is negative. Therefore, $t^{e*} \leq 0$. This inequality can be rearranged as $-(2E+1)t_f^* + E + 1 \leq 0$ (from (13)), which is equivalent to $E \leq 1/3$. ///

Alternatively, we can prove the statement using Equation (11). The first term on the right-hand side of (11) is after-tax profits when all of the company's activities are concentrated in a single jurisdiction, with a corporate

income tax rate t_f. These profits are maximized at q^M, whatever the foreign tax rate. The output q^M is larger than q^* if (and only if) the coefficient multiplying q in the second term on the right side of (11) is negative, i.e., $(t_f - t_h)(\bar{\theta} - c_h) < 0$. Otherwise, the company will want to increase output above q^M. ///

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ENDNOTES

1. In the process, we abandon complex solutions and restrict the domain to $0 < E \leq 3$. Truncating the domain of E eliminates unpleasant situations, where the assumption that tax rates are real numbers in the interior of [0,1] is violated. For example, the host country would like to set $t_f < 0$ when $E > 3$. If B is much larger than A (or $\bar{\theta}$ is very large), the firm will choose an output level, q, which generates negative taxable income in the host country (see Equation (8)). The situation generates positive tax revenues from a negative tax rate on a negative tax base. Similarly, the inequality $E \leq 0$ always implies negative taxable income in one country (e.g., $A > 0$ and $B < 0$ means negative taxable income in the home country). Though those cases may happen in reality, this analysis focuses on the case where a multinational firm creates positive taxable income in each of the two countries. This is a valid argument since, in practice, the mark-up ratio used for the BAPA case is carefully chosen so that positive profit is allocated to each country.

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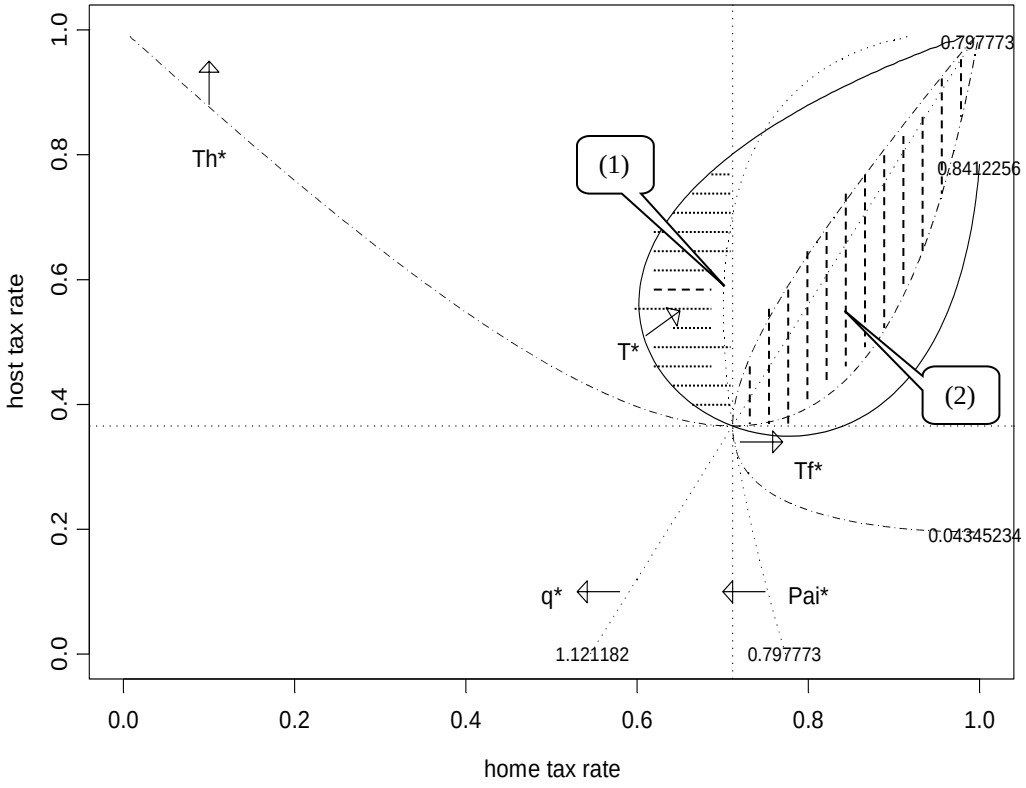
Figure 1: Global Tax Authority Plan Vs. Nash Bargaining Solution



$(E = 1.5)$

T_f^* : an iso-tax-revenue curve for the host government and larger revenues are obtained to the right of the line.

T_h^* : an iso-tax-revenue curve for the home government and larger revenues are obtained above the line.

T^* : an iso-tax-revenue curve for the joint tax revenue, and larger joint tax revenues are obtained above the line.

Pai^* : an iso-profit curve for after-tax profits of the multinational company and larger profits are obtained to the left of the line.

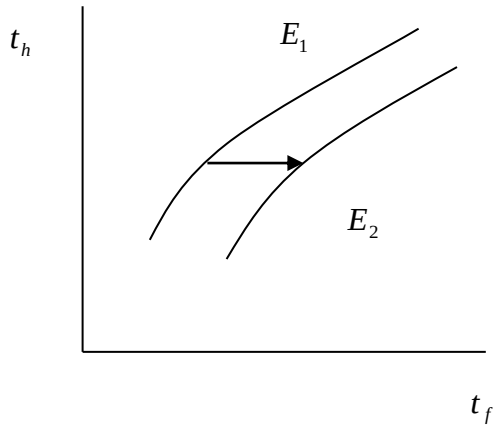
q^* : an iso-quant curve and higher level of consumption is obtained to the left of the line.

Figure 2: Transition Of Equilibrium Tax Rates

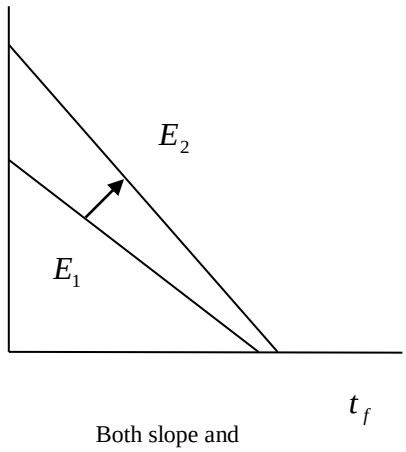
Shift of Best Response Functions

(If $E_1 > E_2$)

2.a Host country



2.b Home country



Both slope and intercept increase

2.c Transition of Equilibrium Tax Rates

(If $E_1 > E_2 > ... > E_n$)